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Parameter	Value	Unit
Initial concentration	1.0	g/L
Initial pH	7.0	
Temperature	25	°C
Time	0, 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768, 65536, 131072, 262144, 524288, 1048576, 2097152, 4194304, 8388608, 16777216, 33554432, 67108864, 134217728, 268435456, 536870912, 1073741824, 2147483648, 4294967296, 8589934592, 17179869184, 34359738368, 68719476736, 137438953472, 274877906944, 549755813888, 1099511627776, 2199023255552, 4398046511104, 8796093022208, 17592186044416, 35184372088832, 70368744177664, 140737488355328, 281474976710656, 562949953421312, 1125899906842624, 2251799813685248, 4503599627370496, 9007199254740992, 18014398509481984, 36028797018963968, 72057594037927936, 144115188075855872, 288230376151711744, 576460752303423488, 1152921504606846976, 2305843009213693952, 4611686018427387904, 9223372036854775808, 18446744073709551616, 36893488147419103232, 73786976294838206464, 147573952589676412928, 295147905179352825856, 590295810358705651712, 1180591620717411303424, 2361183241434822606848, 4722366482869645213696, 9444732965739290427392, 18889465931478580854784, 37778931862957161709568, 75557863725914323419136, 151115727451828646838272, 302231454903657293676544, 604462909807314587353088, 1208925819614629174706176, 2417851639229258349412352, 4835703278458516698824704, 9671406556917033397649408, 19342813113834066795298816, 38685626227668133590597632, 77371252455336267181195264, 154742504910672534362390528, 309485009821345068724781056, 618970019642690137449562112, 1237940039285380274899124224, 2475880078570760549798248448, 4951760157141521099596496896, 9903520314283042199192993792, 19807040628566084398385987584, 39614081257132168796771975168, 79228162514264337593543950336, 158456325028528675187087900672, 316912650057057350374175801344, 633825300114114700748351602688, 1267650600228229401496703205376, 2535301200456458802993406410752, 5070602400912917605986812821504, 10141204801825835211973625643008, 20282409603651670423947251286016, 40564819207303340847894502572032, 81129638414606681695789005144064, 162259276829213363391578010288128, 324518553658426726783156020576256, 649037107316853453566312041152512, 1298074214633706907132624082305024, 2596148429267413814265248164610048, 5192296858534827628530496329220096, 10384593717069655257060992658440192, 20769187434139310514121985316880384, 41538374868278621028243970633760768, 83076749736557242056487941267521536, 166153499473114484112975882535043072, 332306998946228968225951765070086144, 664613997892457936451903530140172288, 1329227995784915872903807060280344576, 2658455991569831745807614120560689152, 5316911983139663491615228241121378304, 10633823966279326983230456482242756608, 21267647932558653966460912964485513216, 42535295865117307932921825928971026432, 85070591730234615865843651857942052864, 170141183460469231731687303715884105728, 340282366920938463463374607431768211456, 680564733841876926926749214863536422912, 1361129467683753853853498429727072845824, 2722258935367507707706996859454145691648, 5444517870735015415413993718908291383296, 10889035741470030830827987437816582766592, 21778071482940061661655974875633165533184, 43556142965880123323311949751266331066368, 87112285931760246646623899502532662132736, 174224571863520493293247799005065324265472, 348449143727040986586495598010130648530944, 696898287454081973172991196020261297061888, 1393796574908163946345982392040522594123776, 2787593149816327892691964784081045188247552, 5575186299632655785383929568162090376495104, 11150372599265311570767859136324180752990208, 22300745198530623141535718272648361505980416, 44601490397061246283071436545296723011960832, 89202980794122492566142873090593446023921664, 178405961588244985132285746181186892047843328, 356811923176489970264571492362373784095686656, 713623846352979940529142984724747568191373312, 1427247692705959881058285969449495136382746624, 2854495385411919762116571938898990272765493248, 5708990770823839524233143877797980545530986496, 11417981541647679048466287755595961091061972992, 2283596308329	

Figure 1 is a schematic drawing of a prior art system 100 for providing IVR services for pre-paid customers. When a call is placed from a wireless device 106 (for example, a wireless telephone), the call is routed to mobile switching system 102 (which contains a Home Location Register (HLR), Visiting Location Register (VLR) and switch) through a first voice path or voice channel 107. The call is then routed through a second voice path 108 to a peripheral device 104. The peripheral device 104 communicates with a database 110 and retrieves information regarding the calling party's account. One of the items peripheral device 104 retrieves is information regarding the amount of funds the calling party has available in the account. It is important to monitor pre-paid customer accounts on a per-call basis to prevent pre-paid customers from exceeding their account balances.

Once peripheral device 104 has retrieved the calling party's account information, peripheral device 104 determines if the calling party has sufficient funds in the account to complete the call. If the peripheral device 104 determines that the calling party has sufficient funds, then peripheral device 104 returns the call back to mobile switch 102 via a third voice path 112. Mobile switching system 102, upon receiving the call from peripheral device 104, then completes the call via a fourth voice path 114.

Alternatively, if peripheral device 104 includes a switch fabric, then peripheral device 104 can complete the call via a fifth voice path 116. In this case, peripheral device 104 would not need to route the call back to mobile switching system 102 via the third voice path 112, nor would the fourth voice path 114 be needed.

Peripheral device 104 must remain active for the duration of the call.

Peripheral device 104 decrements the customer's account in real time during the call, and if the customer exhausts all of the funds available in the account, peripheral device 104 terminates the call. Peripheral device 104 is capable of terminating the call because the voice path is routed through it.

The process for handling incoming calls is similar. Mobile switching system 102 routes the incoming call to peripheral device 104 via a second voice path 108. Peripheral device 104 communicates with database 110 to determine account information and to manage the call. Peripheral device 104 then returns the call to mobile switching system 102 via a third voice path 112. Mobile switching system 102 then completes the call to the mobile device 106 via a first voice path 107.

In addition to participating in every outgoing and incoming call, the peripheral device 104 also provides IVR ("Interactive Voice Response") services. The user of mobile device 106 dials a predetermined number, the "customer service number" or a unique number dedicated to accessing the prepaid IVR, to obtain customer service or prepaid IVR menu access. When the customer service number or unique number is dialed, mobile switching system 102 routes the call to peripheral device 104. This peripheral device can be the same device that manages and accounts for calls, or it can be a different peripheral device

Because peripheral device 104 must both receive instructions from a user and also communicate with the user, two voice paths 108 and 112, one to and one from the peripheral device 104, are required for prepaid IVR services. After peripheral device 104 has been contacted by mobile switching system 102, peripheral device 104

determines that the call is a customer service or prepaid IVR call based on the dialed telephone number. After peripheral device 104 has determined that the customer service number or unique number has been dialed, peripheral device 104 provides customer service by the use of prepaid IVR.

Traditional IVR systems are generally menu-driven, and users indicate their selections by pressing numbers on their numeric keypads. With traditional prepaid IVR systems, users could perform basic functions, such as checking their current account balances.

One of the major drawbacks of conventional pre-paid wireless systems is the number of voice paths, or channels, required to complete a call. In the examples above, either three or four voice paths were required to complete one telephone call. In addition, at least one or two voice paths were required between a mobile switching system and a peripheral device. This conventional arrangement consumes excessive system resources. Additionally, the prior art peripheral devices, such as peripheral device 104 mentioned in the examples above, are expensive and proprietary. They are often custom-built devices that are made for a single application. Thus, they are expensive to purchase or lease, and maintenance is also expensive. Accordingly, the use of a custom-built proprietary device and the use of multiple-voice paths is not cost-effective and consumes excessive system resources.

Another drawback of conventional pre-paid IVR systems is the lack of useful features and the lack of flexibility of the IVR. Conventional pre-paid wireless IVR systems include only basic and rudimentary functions. Because of this, they often fail to fulfill the service needs of customers. When this occurs, customers request the

help of a live CSR (“Customer Service Representative”). Live CSR’s are very costly, and any system that can reduce the number of customers who request the assistance of a live CSR (because they are unsatisfied with the assistance they receive from the IVR), greatly increases cost savings to the wireless communications service provider.

Pre-paid wireless customers are a particular group of customers that frequently request customer assistance. This is due to their accounting arrangement. In contrast to post-paid customers, who receive periodic bills after they have used wireless communications services, pre-paid wireless customers first provide funds to a pre-paid wireless account. As they use wireless communications services, funds are deducted from their pre-paid account. It is often difficult for pre-paid wireless customers to remember the frequency and duration of each call they place, and even more difficult for them to calculate or estimate the amount of funds deducted for each call. In addition to these difficult tasks, pre-paid wireless customers do not always keep a running total of funds deducted from their pre-paid accounts.

Most pre-paid wireless customers do not record or remember such detailed information about their pre-paid accounts, so they frequently resort to calling customer service simply to check the remaining balance on their pre-paid accounts. Another need, the need to add funds to the accounts, also generates frequent calls to customer service. This results in very frequent calls in to customer service by pre-paid wireless customers. Because pre-paid wireless customers tend to be the least profitable customers, traditional pre-paid wireless communications service providers are left in a situation where their least profitable customers are the customers who are the most costly to support. This higher need for customer service to support prepaid

wireless customers forces wireless carriers to purchase or design IVR's that support these needs.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic drawing of a prior art system for providing IVR services for pre-paid customers

Figure 2 is a schematic drawing of a preferred embodiment of the present invention.

Figure 3 is a schematic diagram showing the transactions performed in an embodiment of the present invention.

Figure 4 is a schematic drawing showing a preferred embodiment of a security system.

Figure 5 is a schematic diagram of a main menu for an IVR in a preferred embodiment of the present invention.

Figure 6 is a schematic diagram of a submenu for an IVR in a preferred embodiment of the present invention.

Figure 7 is a schematic diagram of a submenu for an IVR in a preferred embodiment of the present invention.

Figures 8A – 8C are schematic diagrams showing the preferred embodiment of the account profile menu, including submenus, used in the present invention.

Figure 9 is a flow diagram that illustrates a preferred embodiment of the announcement feature of the present invention.

SUMMARY AND OBJECTS OF THE INVENTION

The present invention can be implemented by the use of a wireless communication system that provides interactive voice response including a mobile switching system adapted to communicate with at least one wireless device, for example, a wireless telephone capable of establishing a control channel and a voice channel with the wireless device. The system also includes a Intelligent Network device called a Service Control Point ("SCP") in communication with the mobile switch that is capable of retrieving customer information. The SCP includes an IVR application. The system also includes an Intelligent Network device called an Intelligent Peripheral ("IP") where the IVR announcement recordings or other specialized user interaction resources reside, are under the control of the SCP, and in communication with the mobile switching system. The Intelligent Peripheral is adapted to play voice-recorded messages through a voice channel to the mobile switch, and ultimately to the wireless device. Preferably, the mobile switch communicates with the SCP using CCS7 Intelligent Network signaling. This is also called Transactional Capabilities Application Part ("TCAP") messaging and the SCP communicates with the IP using either TCAP messaging or communications using TCP/IP protocols.

In another aspect, the invention includes a wireless communications system that can route a calling party immediately to the IVR when the system receives a predetermined dialed number. The dialed number can be an abbreviated number.

In another aspect, the invention includes an interactive voice response system for pre-paid wireless services that has a peripheral device in communication with a

one wireless device. An IVR application on the peripheral device including a menu driven system adapted to receive information from a customer. The menu driven system includes provisions that permit users to change the type, frequency, content, and occurrence of prompt information without the assistance of a customer service representative.

Accordingly, the present invention is directed to a wireless communication system that provides interactive voice response that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

An object of the present invention is to conserve system resources.

Another object of the present invention is to provide a system for providing IVR where standard components and devices are used, and the use of custom-built products is reduced or eliminated.

Another object of the present invention is to reduce the cost of purchasing and maintaining an IVR system.

Another object of the present invention is to provide a system that minimizes the number of voice channels or voice paths necessary to complete a pre-paid wireless telephone call.

Another object of the present invention is to reduce the number of customer service calls that request the assistance of a live CSR.

Another object of the present invention is to provide an IVR system that is flexible and can be tailored by each customer.

Another object of the present invention is to provide an IVR system that allows customers to review detailed account information.



Another object of the present invention is to provide an IVR system that allows customers to retrieve details of their transactions.

Another object of the present invention is to provide an IVR system that allows customers to modify and change the type, frequency, content, and occurrence of prompt information without the assistance of a customer service representative.

Another object of the present invention is to provide an IVR system that allows customers to retrieve information regarding locations where they can go to replenish their accounts.

Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and advantages of the invention will be realized and attained by the structure and steps particularly pointed out in the written description, the claims and the drawings.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT(S)

Figure 2 is a schematic drawing of a preferred embodiment of the present invention. System 200 is an Intelligent Network comprising a mobile switching system 202, an SCP ("Service Control Point") 204, and an Intelligent Peripheral ("IP") 206, and an Signaling Transfer Point (STP) 214. In some cases, an Intelligent Network device, called a Service Node (SN), combines the functions of an SCP and an IP. For systems using an SN, a single SN would replace the SCP and the IP. One way to understand the principles of the present invention is to consider an example of

a customer using the interactive voice response system in accordance with the present invention.

A wireless device, for example a mobile phone, 208 places a call. Assuming the customer owning the wireless device has interactive voice response capabilities, the following occurs when the customer places a call. Generally, the entire time the wireless device 208 is within the range of mobile switching system 202, a control channel 210 is established between mobile switch 202 and wireless device 208. In addition to the existing control channel 210, when the call is originated, a voice channel 212 is established between the wireless device 208 and the mobile switching system 202.

When the call is originated, mobile switching system 202 receives the telephone number of the wireless device, and the dialed digits. Usually, the dialed digits is the telephone number of the called party, but the dialed digits can also be a code. Mobile switching system 202 determines if the calling party has Intelligent Network (IN) services. If mobile switching system 202 determines that the calling party has IN services, then mobile switching system 202 initiates communications with SCP 204 for instructions on how to proceed with the call.

Within the initial communication from the Mobile switching system 202 to the SCP 204, the mobile switching system 202 sends the dialed digits, the telephone number or code entered into wireless device 208, and the telephone number, or originating number, of wireless device 208 to SCP 204 using IN TCAP messages. In an exemplary embodiment, IN TCAP messaging according to the wireless standards body known as EIA/TIA-41 Interim Standard (IS) 826, also known as Wireless

exists between mobile switching system 202 and IP 206. After voice channel 218 has been established between mobile switching system 202 and IP 206, IP 206 communicates with the SCP 204 and informs SCP 204 that a voice channel 218 has been established and waits for the next instruction. The communications between IP 206 and SCP 204 are conducted using IN TCAP messaging or are conducted using TCP/IP Protocol.

In this embodiment of the invention, the provisions that provide the voice prompts and voice message recordings of IVR services reside on IP 206. In this embodiment, IP 206 is the device that actually speaks to the customer. After IP 206 queries SCP 204, SCP 204 returns information to IP 206 and permits IP 206 to send the appropriate voice messages to wireless device 208 via mobile switching system 202.

Figure 3 shows an embodiment of the present invention expressed in a transactional diagram. These diagrams are sometimes referred to as “Ping-Pong” diagrams.

Starting in the upper right hand corner, a wireless device, such as a wireless telephone 322 or a land line telephone 320 places a call to an appropriate telephone number. In first step 301, the call is routed to mobile switch 324. The wireless device 322 preferably dials abbreviated dialing digits and the land line telephone preferably dials a toll free number. Once mobile switch 324 receives the call, the mobile switch 324 communicates to the Home Location Register (HLR) 326 in step 301A using IN TCAP messaging. HLR 326 determines if the call requires the use of any IN services. Preferably, HLR 326 determines whether IN services are required

for the call by using the dialed digits from landline 320 or the originating number of mobile device 322. In step 301B, HLR returns the call to mobile switch 324, preferably using IN TCAP messaging, with instructions on how to route the call. If the call does not require IN services, then mobile switch 324 routes the call in a known manner. If the call requires IN services, as is the case in this example, then mobile switch 324 requests instructions on how to route the call from SCP 328 in step 302A. Preferably, communications between mobile switch 324 and SCP 328 are conducted in either TCP/IP or IN TCAP messaging.

An application for prepaid customers preferably resides on SCP 328. Once the SCP's prepaid application determines that the dialed number should be routed to an IVR system, SCP 328 will send a TCAP message to mobile switch 324. This message from SCP 328 to mobile switch 324 is shown as step 303. This message informs mobile switch 324 to establish a voice connection between itself and an IP 330. In step 304, a voice path is established between IP 330 and mobile switch 324 using an Integrated Services Digital Network User Part (ISUP) type voice trunk.

In steps 305 and 306, IP 330 communicates with SCP 328. IP 330 requests instructions from SCP 328 and SCP 328 responds to those questions by commanding IP 330 to play various messages. In step 307, IP 330 plays an initial announcement or message to the customer over the established voice path. In the step 308, the calling party and IP 330 interact as the calling party transmits commands to IP 330. IP 330 responds to those commands and provides the calling party with requested information. The interaction between the calling party and IP 330 continues for some

time until the calling party hangs up or the call is interrupted. After the call has ended, in step 309 the system performs TCAP disconnect procedures.

The IVR Session

The present invention includes unique IVR features. But, before customers can access these features, they must first navigate through a system of security by providing proof of their identity to the system in order to gain access to IVR customer support.

Figure 4 is a schematic showing a preferred embodiment of a security system. Wireless device 402 can gain access to IVR customer support by dialing a predetermined number. In a preferred embodiment, the predetermined number is an abbreviated number containing less than 10 digits. In another preferred embodiment, the predetermined number is a three digit number. In an exemplary embodiment, the predetermined number is x11, for example, 511, 611, or 711.

A customer can also gain access to IVR customer support through a land line phone 404. Preferably, a customer gains access to IVR customer support through a land line phone 404 by dialing a different, second predetermined number. Preferably, this second predetermined number is a 1-800 number, for example, 1-800-XXX-XXXX, where the X can represent different numbers.

Once a customer dials either one of those predetermined numbers, the call is routed to the IVR customer support system 400. The first step 406 of the system is to permit customers to select the appropriate language for the IVR customer support session. This step is optional and some embodiments of the present invention omit

Alcohol	$1/T \times 10^3 \text{ K}^{-1}$	$\log k$
EtOH	10.5	2.5
	11.5	3.5
	12.5	4.5
	13.5	5.5
MeOH	10.5	2.8
	11.5	3.8
	12.5	4.8
	13.5	5.8
iPrOH	10.5	3.2
	11.5	4.2
	12.5	5.2
	13.5	6.2
tBuOH	10.5	3.5
	11.5	4.5
	12.5	5.5
	13.5	6.5

Alcohol	$1/T \times 10^3 \text{ K}^{-1}$	$\log k$
EtOH	10.5	2.5
	11.5	3.5
	12.5	4.5
	13.5	5.5
MeOH	10.5	2.8
	11.5	3.8
	12.5	4.8
	13.5	5.8
iPrOH	10.5	3.2
	11.5	4.2
	12.5	5.2
	13.5	6.2
tBuOH	10.5	3.5
	11.5	4.5
	12.5	5.5
	13.5	6.5

Assuming the correct passcode has been received, system 400 then sends the customer to the IVR main menu 418. Before the customer is sent to IVR main menu 418, an optional message 416 containing the customer's current account balance can be played.

As shown in Figure 5, IVR main menu 418 contains several options. In the example shown in Figure 5, customers can choose any one of the following options: (1) add to an account or listen to account information 501, (2) technical assistance and roaming information 502, (3) replenishment locations or sales 503, (4) account profile 504, (5) promotions 505. Customers enter their selection by pressing the number corresponding to their choice on their numeric keypad.

A numbering convention is used throughout this disclosure. An example of a possible number that could be used to designate a particular choice is shown in the item. For example, the numbers shown in items 501-505 are examples of numbers than can be assigned to those options. In this example, the customer would press the number 4 on their numeric keypad to receive information regarding their account profile. Additionally, there are three options available to the customer at all times. The customer can, at any time, press "0" to speak with a CSR, the customer can press "9" to have the current menu options replayed, or the customer can press "*" to return to the main menu.

(1) Add to account or listen to account information 501

If the customer chooses the first option, namely, to add to the account or listen to account information by pressing "1", the customer is presented with an array of

options in this category, as shown in Figure 6. The options are (1) add to account using a pre-paid card 601, (2) account balance 602, (3) last five calls 603, (4) last five replenishments 604, (5) rate plan information 605.

By selecting "1" in menu 501, customers can add to their accounts.

Preferably, this option allows additions to accounts by the use of certain types of transactions. Preferably, those transactions include the use of pre-paid calling cards that include PIN's. Unlike the PIN's (Personal Identification Numbers) used in the banking industry in connection with automated teller machines that confirm the identity of a customer as the legitimate owner of a card, PIN's in the context of pre-paid wireless communications services refer instead to numbers on pre-paid calling cards. These calling cards can be purchased in various denominations.

At step 601, system 400 requests the entry of a PIN. When customers enter the PIN number, system 400 can determine the value added to the customer's account, based on the PIN. System 400 can also determine if an invalid or fraudulent pin number has been entered. If an invalid number has been entered, system 400 will refuse to add value to the customer's account and may notify the customer of the error. System 400 may also provide additional opportunities to the customer to enter a valid pin number.

Assuming a valid pin number has been entered by the customer, system 400 then adds the value to the customer's account. After the customer has added funds to the pre-paid wireless account, system 400 preferably confirms the dollar amount of the transfer and can also preferably indicate the new account balance in step 608.

Customers can also check their account balances by selecting "2". System 400 responds to this selection by telling the customer the current account balance. System 400 can also tell customers the expiration date for their accounts. Some wireless telephone service providers limit the duration of accounts. This can be accomplished by setting an expiration date with pre-paid cards. The expiration dates can vary with the amount of the calling card. For example, a \$10.00 may have an expiration date 30 days after first use, a \$20.00 card may last 45 days, a \$30.00 card may last 60 days and so on. As new pre-paid cards are added to the account, the expiration date of the account is reset. By selecting "2," customers can listen to the current expiration date for their account.

By selecting "3" customers can retrieve information regarding their last several calls. Either a predetermined number of calls, for example 5, or a selected number of calls can be retrieved. The system can ask the customer for the number of previous calls, once that number has been received by the system, the system plays back information regarding those calls. Once the number of calls has been determined, system 400 gives the customer information related to those calls. In a preferred embodiment, system 400 tells the customer the date and time of the call, whether the call was an incoming or outgoing call, the duration of the call, the cost of the call, and the other party's telephone number. For example, system 400 could recite the following to the customer, "January 2nd incoming call at 8:42AM for 12 minutes from 707-555-1122." System 400 could continue to recite the other recent calls in a similar manner. System 400 can recite all of the selected items, or system

400 can wait after an item has been recited for the customer to respond, preferably by pressing a button, before proceeding to the next item.

Selection 4 from this menu permits customers to review the last several replenishment transactions. Either a predetermined number of calls, for example 5, or a selected number of calls can be retrieved. The system can ask the customer for the number of previous calls, once that number has been received by the system, the system plays back information regarding those calls. Once the number of calls has been determined, system 400 gives the customer information related to those calls. Once the number of previous replenishment transactions has been determined, system 400 gives the customer information related to those transactions. In a preferred embodiment, system 400 tells the customer the date and time of the transaction, along with the amount. For example, system 400 could recite the following to the customer, "On December 23rd, at 8:50PM, fifty dollars were added to your account." System 400 would continue to recite the other recent transactions in a similar manner. System 400 can recite all of the selected items, or system 400 can wait after an item has been recited for the customer to respond, preferably by pressing a button, before proceeding to the next item.

Customers can retrieve information regarding their current rate plan by selecting "5". System 400 can be programmed so that any information related to the plan can be disclosed to the customer. Preferably, system 400 tells the customer the name of the rate plan, the features and services that are included in the rate plan, and the amount of any fees, for example, daily access fees, or other charges associated with the rate plan.

(2) Technical assistance and roaming information 502

In choosing the second option, the customer requests technical assistance or information related to roaming. After the system has received this selection, the system preferably refers the customer to a technical service representative. This representative assists the customer with any technical problems and can provide customers with roaming information.

(3) Replenishment locations or sales

There are several ways to add funds to a pre-paid wireless account. Customers can go to a store or kiosk that sells and services wireless phones. From there, customers can deal directly with a customer service representative, make payment, and have the CSR contact the pre-paid wireless service provider to inform the provider that additional funds have been placed in the customer's account.

Another option available to customers is the use of pre-paid cards, mentioned above. These cards are widely available at a variety of different locations, such as convenience stores (7-Eleven for example), electronics stores (Circuit City or Best Buy, for example), discount stores, grocery stores and other retail outlets.

These pre-paid cards are available in various denominations, for example, \$5.00, \$10.00, \$20.00, \$50.00, etc. These cards contain the PIN numbers discussed above, and are used to replenish pre-paid wireless accounts by the value of the card. Of course, the value of the card in wireless service could vary from the purchase price of the card. Cards can be worth more in wireless service than their purchase price in

order to give customers volume discounts for purchasing higher denomination cards. After the cards have been purchased, customers can use the IVR system to add the value of the card to their pre-paid accounts, as discussed above.

Referring to Figures 5-7, system 400 includes provisions to assist customers in finding the nearest location of a store or venue where these special cards are available for purchase. Option 3 (item 503 in Figure 5) in main menu 418 corresponds to the selection, "Replenishment Locations." When a customer selects this option, system 400 enters the menu for this option in step 700 and offers a choice in step 702. The customer can choose to either speak with a CSR (1), or enter a zip code (2). If the customer chooses option (1), then the customer's call is routed to a CSR in step 704. If the customer chooses to enter a zip code, system 400 requests entry of a zip code and receives the current zip code of the customer in step 706. After the zip code has been entered, system 400 retrieves selected location information in step 708.

This location information can be stored in the same device or peripheral where the IVR application resides, or the location information can be stored on a database that is separate from the device or peripheral that houses the IVR application. Preferably, the location information can be stored in a database. This database can reside on IP 206, SCP 204 or in a separate system. Preferably, the location information is stored according to zip code for fast retrieval.

There are many different ways the IVR system 400 can recite the locations to the customer in step 708. All, some, or one of the locations associated with a given zip code could be recited to the customer. The number of locations recited can be

varied depending on the preferences of the customer and/or the discretion of the IVR service provider. Preferably, five locations are recited to the customer.

There are also many different ways the list of selected locations can be ordered when recited to the customer. In other words, system 400 can determine which location is recited first, second, third, and so on, to the customer. In addition, the list of retrieved locations can be randomized, and the first several locations can be recited to the customer. In an exemplary embodiment of the present invention, all of the locations for a particular zip code are placed in random order. This randomizing can occur once, at pre-selected time intervals, for example, every 10 minutes, every hour, every day, or every time a customer requests a list of locations. After the list has been randomized, the first five locations are recited to the customer.

If the list of recited locations is less than all of the locations for a particular zip code, then the customer can opt to listen to additional locations. In the exemplary embodiment, after the customer has listened to the first five locations, the customer can opt to listen to the next five locations, and so on.

Preferably, when the locations are recited, the name of the store or venue is recited, along with the street address. Relevant landmarks, adjacent major roads, and/or directions can also be recited along with the name and the street address.

(4) Account Profile

If the customer selects “account profile” from main menu 418 by entering “4,” then the customer is directed to the account profile menu 800. Preferably, account profile menu 800 includes several different options. Some options available on

account profile menu 800 preferably include (1) the ability to change the customer's password or passcode, (2) the ability to change the spoken language of the voice prompts; and (3) the ability to vary the prompt level. Systems can include anywhere from none, one, several or all of these options. In addition, systems can also include additional options that vary account preferences or account profile characteristics.

The preferred embodiment of the account profile menu is shown schematically in Figure 8. After the customer has entered "4" in the main menu, the customer is directed to the account profile menu 800. Preferably, after the customer is directed to the account profile menu 800, the system recites the account profile menu 800 options. In one embodiment of the present invention, the system recites, "To change password (or passcode), press 1; to change language preference, press 2; to select prompt level, press 3; and to deactivate your account press 5." After hearing the menu options, the customer enters a selection.

If the customer wants to change the password or passcode, the customer would select the first option 802, preferably by entering the number 1. After the selection has been received by the system, the system then moves on to the next step 804, where the system asks the customer to enter a new password or passcode.

After the new password or passcode has been received by the system, the system moves on to the third step 806 where the system replays the data entered by the customer. After the data has been replayed, the system asks the customer if the replayed data is correct. Preferably, the system confirms the new password or passcode by asking the customer to enter a response, for example, pressing the number "1," if the replayed data corresponds with the new password or passcode. If

the customer responds with a "1," for example, then the system knows that the new password or passcode is correct. The system associates that password or passcode with the customer. If a different response is received or if no response is received, the system can inform the customer that the new password or passcode has not been accepted. The system can then either return to the first step 802 of the change password or passcode menu, return to the main menu, or exit out of the system.

If the customer wants to change the spoken language used by the system for their prompts, then the customer would select the change language preference menu 808. Preferably, the customer indicates this section by entering a "2." Once the customer has selected the change language preference menu 808, the system then offers a variety of language choices to the customer.

Any number of suitable number of language choices can be offered. Preferably, the language choices offered reflect the languages that are used by customers. In an exemplary embodiment, two language choices, English and Spanish are offered. Other language choices could also be offered. Preferably, the system recites the various language choices in the second step 810 of the change language selection 808. Preferably, the language choices are recited in the language offered and the language choices preferably correspond to a number.

After the language choices have been offered, the system gives the customer the opportunity to enter a selection. Once the system has received the selection, the system progresses to the third step 812 of the change language selection. In this third step 812, the system confirms the language selection. Preferably, the system asks the customer to confirm the language selection by entering a number. If the system

the customer selects “2” for minimum prompts, the system associates the minimum prompt selection with the customer in step 820.

In the context of this embodiment, maximum announcements refers to the option where customers hear a series of announcements every time they make a call. The service provider can vary the content of those announcements. For example, one possible announcement would include the current account balance, the time and date of the last incoming or outgoing call, the duration of the call, and the cost of the call. Of course, different types of messages related to the customer's account or calling activity can be included in the announcement. Also, the announcement mentioned above could be shortened and different aspects of the announcement could be removed.

If the customer opts for minimum prompts, the customer receives the announcement whenever their account balance falls below a predetermined level. The level can be set either in monetary units or in time units. For example, if the predetermined level is set at \$10.00, then the system plays the announcement to the customer when the customer's account balance falls below \$10.00. Another

predetermined level could be zero minutes or zero dollars. This predetermined level can be set to any level desired by the service provider.

Another approach is to have a predetermined level based on the number of minutes available in the account. With taxes, tariffs, long distance charges, roaming charges, land line access fees and other charges that affect the cost of a call, it is difficult to determine, with exact certainty, how many minutes are available to a customer. So the system estimates the amount of time available in a customer's account. Any suitable method of estimating the time remaining may be used. One example of estimating the remaining time is to compute the average cost per unit time historically, and use that rate, along with the remaining account balance, to estimate the remaining time.

In another embodiment, additional flexibility is offered to the customer to specifically tailor the various announcement parameters. A sub-menu 822 provide announcement options to customers. When customers enter this sub-menu 822, the system informs them of their choices. Some options available to customers include (1) the method of delivery 824; (2) the content 826; (3) pre or post call 828; and (4) frequency 830. Customers preferably indicate a selection by pressing the corresponding number on their keypads.

By selecting "1," the customer can choose the way in which the announcement is delivered to them. The announcement can be delivered as a voice message, as disclosed above, or the announcement can be sent as a text message that is displayed on their wireless telephones. Preferably, SMS (Short Messaging Services) protocol in

accordance with wireless telecommunications standards organizations such as TIA/EIA- 41 or ETSI, is used to send the text messages.

Customers can modify the content of the announcement by selecting “2.” This places the customer in sub-menu 826. The system offers many different possible messages including current account balance, the time and date of the last incoming or outgoing call, the duration of the call, the cost of the call, and information related to the last replenishment. Other types of messages related to the customer’s account or calling activity can also be included in the announcement. When customers enter sub-menu 826, they have the ability, by navigating through the sub-menu, to pick and choose which messages they want included in their announcement.

By selecting “3,” customers enter a sub-menu 828, where they can select either pre or post call announcements. A pre-call announcement is an announcement that is played when the customer originates an outgoing call. Before the call is connected (that is, before the called party is connected to the call) the announcement is played to the customer. A post-call announcement is an announcement that is played after a call has ended. In order for a customer to hear a post-call announcement, the customer stays on the line after the other party has hung up. This signals the system that the customer is waiting for a post-call announcement. After the system has sensed that the customer is still on the line after the other party has hung up, the system plays a post-call announcement. In sub-menu 828, customers can elect to receive either pre or post-call announcements. Customers can also elect to receive both pre and post-call announcements.

The fourth option is the frequency option. Customers enter sub-menu 830 by pressing "4." In sub-menu 830, customers can select the frequency of their announcements. In other words, customers can tell the system how often they would like to receive the announcement.

Some frequency options include a set period. For example, one option could be that the announcement is played every time a call is made or received. Another period could be that the announcement is played every several calls, for example, every 5th call or every 10th call.

Another period could be time. The customer could set the period to be every 10 minutes of usage or every 30 minutes of usage. With these time related periods, the system would play the announcement during the next available pre or post-call opportunity after the customer has used the telephone for the pre-selected period of time. In the examples given above, the system would wait for the customer to use the telephone for the pre-selected period of time, and then after that period of time has been exceeded, the system would play the announcement at the next available opportunity. By waiting for the next available opportunity, the system does not play the announcement during a call or while another party is on the line. The announcement may contain personal and confidential information and is intended solely for the customer. By waiting for an available opportunity, the system endeavors to protect the confidential information of the customer.

Available funds is another frequency option. Like the time option, customers could select a certain dollar amount as their period. One example is \$10.00. So, the system would play the announcement every time the customer's account was reduced

by \$10.00. Similar to the time period option, the system waits for an appropriate opportunity to play the announcement.

Another option is a threshold option. Using this option, the customer does not receive any announcements until the account balance falls below a pre-selected level. For example, if the level was set at \$10.00, the customer would hear no announcements until the customer's account balance fell below \$10.00. Then, after the account balance fell below that level, the system would play the announcement at every call.

Figure 9 is a flow diagram that illustrates a preferred embodiment of the announcement feature. The items referred to in Figure 9 are shown schematically in Figure 2. The process starts 902 in one of two ways. For pre-call announcements, the process starts when the customer originates an outgoing call by sending dialed digits from a wireless phone. For post-call announcements, the process begins when the system senses that a pre-paid wireless customer did not hang up after the other party has hung up. In other words, the customer stays on the line after the other party hangs up. If either of these two conditions is met, the process begins.

In step 904, Mobile switching system 202 receives both the telephone number of the customer along with the dialed digits. Mobile switching system 202 communicates with SCP 204 and notifies SCP 204 that a mobile number associated with a customer has originated a call that includes dialed digits.

In step 906, a pre-paid application 216 on SCP 204 uses the mobile number to retrieve account information associated with that mobile number. This account

information preferably includes features and services purchased by the customer, account balance information, and announcement preferences.

Once the account information has been retrieved, SCP 204 determines, in step 908, if an announcement should be made. If SCP 204 determines that no announcement is necessary, SCP 204 directs mobile switch 202 to complete the call.

If SCP 204 determines that an announcement is necessary, SCP 204 will then determine the method by which the announcement should be sent to the customer in step 912. In step 912, SCP 204 determines if a voice message should be sent or a text message should be sent. If a voice message is to be sent, SCP 204 retrieves the announcement content preferences and instructs IP 206 to play an announcement containing the content selected by the customer. This is accomplished in step 914. After the announcement has ended, SCP 204 instructs mobile switch 202 to complete the call in step 918. If the customer has selected a text message, SCP 204 retrieves the announcement content preferences and delivers a text message containing the content selected by the customer by known methods. Preferably, SMS is used to deliver the text message to the customer's wireless telephone. The text message is delivered in step 916. After the text message has been sent, or while the text message is being sent, SCP 204 instructs mobile switching system 202 to complete the call in step 918.

Post-call announcements progress in a similar fashion. However, the progression of post-call announcements include the following differences. As described above, post-call announcements are started in step 902 by mobile switching

system 202 detecting the condition that a pre-paid wireless customer did not hang up after the other party hung up.

Another difference between pre and post-call announcements is the progression of the call at step 912. For post-call announcements that are sent by an SMS text message, SCP 204 can terminate the call at step 912, after SCP 204 has determined that a SMS text message has been requested instead of a voice message. There is no need to maintain a voice channel to transmit text to the customer's wireless telephone, so to conserve system resources, mobile switching system 202 is preferably instructed to terminate the voice channel as soon as SCP 204 has determined that a text message instead of a voice message is to be delivered.

(5) *Promotions 505*

Selecting "5" allows customers to listen to promotions offered by the wireless telephone service provider. Preferably, the system includes provisions that permit the service provider to change and alter the promotion information throughout the year. The system also preferably permits multiple promotions that are accessible to customers through a sub-menu under promotions 505.

The foregoing disclosure of embodiments of the present invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many variations and modifications of the embodiments described herein will be obvious to one of

ordinary skill in the art in light of the above disclosure. The scope of the invention is to be defined only by the claims appended hereto, and by their equivalents.

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